CLAIM AMENDMENTS

1. (Allowed) A method of characterizing spectrometer instruments according to instrument variation, comprising the steps of:

providing at least one standard spectrum from at least one spectrometer instrument; and

classifying said at least one spectrometer instrument into at least one of a plurality of predefined clusters on the basis of features extracted from said at least one spectrum; and

providing at least one calibration ~~models~~ for each of said predefined clusters that models instrument variation of instruments classified to the cluster.

2. (Allowed) The method of Claim 1 wherein said instrument variation comprises any of:

wavelength shifts;
nonlinear wavelength shifts;
wavelength expansions;
wavelength contractions;
nonlinear wavelength expansions;
source intensity drifts;
blackbody profile changes;
bandwidth changes;
resolution changes;
baseline deviations;
changes over time;
temperature effects;
detector response;
differences in optical components;
variation related to mounting of references;
differences in the optical interface to the sample;
linearity; and
detector cut-off.

3. (Allowed) The method of Claim 1, wherein said standard spectra are measured on a plurality of spectrometer instruments.

4. (Allowed) The method of Claim 1, wherein said standard sp ctral are measured on a single spectrometer instrument at successive time intervals.

5. (Allowed) The method of Claim 1, wherein said classifying step comprises the steps of:

extracting features; and

classifying said features according to a classification model and decision rule.

6. (Allowed) The method of Claim 5, wherein said feature extraction step comprises any mathematical transformation that enhances a particular aspect or quality of data that is useful for interpretation.

7. (Allowed) the method of Claim 5, wherein said classification model comprises means for determining a set of similarity measures with predefined classes.

8. (Allowed) The method of Claim 5, wherein said decision rule comprises means for assigning class membership on the basis of a set of measures calculated by a decision engine.

9. (Allowed) The method of Claim 1, wherein individual features are divided into two categories, said categories comprising:

abstract features wherein said features are extracted using various computational methods; and

simple features that are derived from an *a priori* understanding of a system, wherein said feature is directly related to an instrument parameter or component.

10. (Allowed) The method of Claim 9, wherein said abstract features are calculated using any of:

plotting primary principal components versus one another and identifying resulting clusters;

discriminant analysis; and

k-means clustering.

11. (Allowed) The method of Claim 5, wherein said classification step further comprises the step of employing factor-based methods to build a model capable of representing variation in a measured spectrum related to variations in spectral response;

wherein projection of a measured absorbance spectrum onto said model constitutes a feature that represents spectral variation related to instrument variation.

12. (Allowed) The method of Claim 5, wherein said classifying step further comprises the steps of:

measuring the similarity of a feature to predefined clusters; and

assigning membership in a cluster.

13. (Allowed) The method of Claim 5, further comprising the step of:

assigning measurements in an exploratory data set to clusters.

14. (Allowed) The method of Claim 13, further comprising the step of:

using measurements and class assignments to determine a mapping from features to cluster assignments.

15. (Allowed) The method of Claim 13, further comprising the steps of:

defining clusters from said features in a supervised manner, wherein each set of features is divided into two or more regions, and wherein classes are defined by combinations of feature divisions;

designing a classifier subsequent to class definition through supervised pattern recognition by determining an optimal mapping or transformation from the feature space to a class estimate which minimizes the number of misclassifications; and

creating a model based on class definitions which transforms a measured set of features to an estimated classification.

16. (Allowed) The method of Claim 1, further comprising the step of applying said calibration models to analysis of new sample measurements.

17. (Allowed) The method of Claim 16, wherein said calibration models model differences between said predefined clusters.

18. (Allowed) The method of Claim 16, wherein a master calibration model is developed for a first of said clusters from a set of exemplar spectra with reference values and pre-assigned classification definitions.

19. (Allowed) The method of Claim 18, further comprising the step of transferring said master calibration model to a plurality of slave calibration models, wherein a slave calibration model is calculated for each remaining cluster, and wherein a transform modifies said master calibration model to a slave calibration model in accordance with principal features defining each of said classes.

20. (Allowed) The method of Claim 19, wherein said transferring step comprises the steps of:

transferring said master calibration model to a first slave calibration model;

transferring said first slave calibration model to a second slave calibration model;

and repeating said transfer from one slave calibration model to another slave calibration model, until a calibration has been provided for each of said predefined clusters;

wherein a transform modifies said transferred calibration models in accordance with principal features defining each of said clusters.

21. (Allowed) The method of Claim 18, further comprising the step of transferring said master calibration model to a plurality of slave calibration models, wherein a slave calibration model is calculated for each remaining cluster, and wherein a transform modifies said slave calibration model to said master calibration model in accordance with principal features defining each of said classes.

22. (Allowed) The method of Claim 21, wherein said transferring step comprises the steps of:

transferring said master calibration model to a first slave calibration model;

transferring said first slave calibration model to a second slave calibration model;

and repeating said transfer from one slave calibration model to another slave calibration model, until a calibration has been provided for each of said predefined clusters;

wherein a transform modifies said transferred calibration models in accordance with principal features defining each of said clusters.

23. (Allowed) The method of Claim 16, wherein a different calibration model is developed for each cluster, and wherein said calibration models are developed from a set of exemplar spectra, with reference values and pre-assigned cluster definitions.

24. (Allowed) The method of Claim 23, wherein a spectrum is assigned to one of many of said predefined clusters for which a calibration model has been developed.

25. (Allowed) The method of Claim 1, further comprising the steps of:

providing new spectral measurements;

comparing said new spectral measurements to each of said pre-defined clusters according to extracted spectral features;

reporting those measurements as outliers for which a matching cluster is not found.

26. (Allowed) A method of developing calibration models for spectral analysis comprising the steps of:

defining clusters from an exemplar data set of spectral measurements, wherein said clusters exhibit a high degree of internal similarity;

mapping said clusters to one another, wherein principal features distinguishing clusters from one another are determined;

calculating a calibration model for a first of said clusters, said calibration model comprising a master calibration;

transferring said master calibration to at least one slave calibration, wherein a slave calibration comprises a calibration derived by applying a transform to slave spectra such that the master calibration now models the difference between the master cluster and another cluster corresponding to said slave spectra.

27. (Allowed) A method of characterizing spectrometer instruments according to instrument variation, comprising the steps of:

collecting spectra using at least one optical spectrometer instrument; and

classifying said spectra into predefined clusters on the basis of extracted spectral features; and

providing calibration models for each of said predefined clusters, wherein said calibration models model instrumental variation.

28. (Allowed) A method of characterizing spectrometer instruments according to instrument variation, comprising the steps of:

collecting spectra using at least one spectrometer instrument; and

classifying said spectra into predefined clusters on the basis of extracted spectral features; and

providing calibration models for each of said predefined clusters, wherein said calibration model is applied to a new spectral measurement.

29. (Allowed) A method of characterizing spectrometer instruments according to instrument variation, comprising the steps of:

collecting spectra using at least one spectrometer instrument; and

classifying said spectra into predefined clusters on the basis of extracted spectral features; and

providing calibration models for each of said predefined clusters, wherein said calibration models model said instrument variation; and

wherein said at least one spectrometer instrument is not a mass spectrometer.

30. (Allowed) A method of characterizing spectrometer instruments according to instrument variation, comprising the steps of:

collecting at least one spectrum using at least one spectrometer instrument; and

classifying said spectrometer instrument into predefined clusters on the basis of extracted spectral features; and

providing calibration models for each of said predefined clusters.

31. (Allowed) The method of Claim 30, wherein said calibration models model instrument variation.

32. (Allowed) The method of Claim 3, wherein said instrument variation comprises any of:

wavelength shifts;
nonlinear wavelength shifts;
wavelength expansions;
wavelength contractions;
nonlinear wavelength expansions;
source intensity drifts;
blackbody profile changes;
bandwidth changes;
resolution changes;
baseline deviations;
changes over time;
temperature effects;
detector response;
differences in optical components;
variation related to mounting of references;

differences in the optical interface to the sample;
linearity; and
detector cut-off.

33. (Allowed) The method of Claim 30, wherein said standard spectra are measured on a plurality of spectrometer instruments.

34. (Allowed) The method of Claim 30, wherein said standard spectral are measured on a single spectrometer instrument at successive time intervals.

35. (Allowed) The method of Claim 30, wherein said classifying step comprises the steps of:

extracting features; and
classifying said features according to a classification model and decision rule.

36. (Allowed) The method of Claim 35, wherein said feature extraction step comprises any mathematical transformation that enhances a particular aspect or quality of data that is useful for interpretation.

37. (Allowed) The method of Claim 35, wherein said classification model comprises means for determining a set of similarity measures with predefined classes.

38. (Allowed) The method of Claim 35, wherein said decision rule comprises means for assigning class membership on the basis of a set of measures calculated by a decision engine.

39. (Allowed) The method of Claim 30, wherein individual features are divided into two categories, said categories comprising:

abstract features wherein said features are extracted using various computational methods; and

simple features that are derived from an *a priori* understanding of a system, wherein said feature is directly related to an instrument parameter or component.

40. (Allowed) The method of Claim 39, wherein said abstract features are calculated using any of:

plotting primary principal components versus one another and identifying resulting

clusters;

discriminant analysis; and

k-means clustering.

41. (Allowed) The method of Claim 35, wherein said classification step further comprises the step of employing factor-based methods to build a model capable of representing variation in a measured spectrum related to variations in spectral response;

wherein projection of a measured absorbance spectrum onto said model constitutes a feature that represents spectral variation related to instrument variation.

42. (Allowed) The method of Claim 35, wherein said classifying step further comprises the steps of:

measuring the similarity of a feature to predefined clusters; and

assigning membership in a cluster.

43. (Allowed) The method of Claim 35, further comprising the step of:

assigning measurements in an exploratory data set to clusters.

44. (Allowed) The method of Claim 43, further comprising the step of:

using measurements and class assignments to determine a mapping from features to cluster assignments.

45. (Allowed) The method of Claim 43, further comprising the steps of:

defining clusters from said features in a supervised manner, wherein each set of features is divided into two or more regions, and wherein classes are defined by combinations of feature divisions;

designing a classifier subsequent to class definition through supervised pattern recognition by determining an optimal mapping or transformation from the feature space to a class estimate which minimizes the number of misclassifications; and

creating a model based on class definitions which transforms a measured set of features to an estimated classification.

46. (Allowed) The method of Claim 30, further comprising the step of applying said calibration models to analysis of new sample measurements.

47. (Allowed) The method of Claim 46, wherein said calibration models model differences between said predefined clusters.

48. (Allowed) The method of Claim 46, wherein a master calibration model is developed for a first of said clusters from a set of exemplar spectra with reference values and pre-assigned classification definitions.

49. (Allowed) The method of Claim 48, further comprising the step of transferring said master calibration model to a plurality of slave calibration models, wherein a slave calibration model is calculated for each remaining cluster, and wherein a transform modifies said master calibration model to a slave calibration model in accordance with principal features defining each of said classes.

50. (Allowed) The method of Claim 49, wherein said transferring step comprises the steps of:

transferring said master calibration model to a first slave calibration model;

transferring said first slave calibration model to a second slave calibration model;

and repeating said transfer from one slave calibration model to another slave calibration model, until a calibration has been provided for each of said predefined clusters;

wherein a transform modifies said transferred calibration models in accordance with principal features defining each of said clusters.

51. (Allowed) The method of Claim 48, further comprising the step of transferring said master calibration model to a plurality of slave calibration models, wherein a slave calibration model is calculated for each remaining cluster, and wherein a transform modifies said slave calibration model to said master calibration model in accordance with principal features defining each of said classes.

52. (Allowed) The method of Claim 30, wherein said transferring step comprises the steps of:

transferring said master calibration model to a first slave calibration model;

transferring said first slave calibration model to a second slave calibration model;

and repeating said transfer from one slave calibration model to another slave calibration model, until a calibration has been provided for each of said predefined clusters;

wherein a transform modifies said transferred calibration models in accordance with principal features defining each of said clusters.

53. (Allowed) The method of Claim 46, wherein a different calibration model is developed for each cluster, and wherein said calibration models are developed from a set of exemplar spectra, with reference values and pre-assigned cluster definitions.

54. (Allowed) The method of Claim 53, wherein a spectrum is assigned to one of many of said predefined clusters for which a calibration model has been developed.

55. (Allowed) The method of Claim 30, further comprising the steps of:

providing new spectral measurements;

comparing said new spectral measurements to each of said pre-defined clusters according to extracted spectral features;

reporting those measurements as outliers for which a matching cluster is not found.

~~56. A method of generating an analyte prediction comprising steps of:~~

~~collecting a sample spectrum;~~

~~providing a plurality of pre-defined clusters with corresponding calibration models, wherein each cluster is defined according to spectral features characteristic of state of at least one spectrometer instrument;~~

~~mapping said sample spectrum to one of said predefined clusters; and~~

~~applying the corresponding calibration model to generate said analyte prediction.~~

~~57. The method of Claim 56, wherein state comprises any of:~~

~~variation of a single spectrometer over time; and~~

~~variation between spectrometers.~~

~~58. The method of Claim 56, further comprising a step of:~~

~~classifying said at least one spectrometer instrument into at least one of said clusters.~~

~~59. The method of Claim 58, said step of classifying comprising:~~

~~extracting features; and~~

~~classifying said features according to a classification model and decision rule.~~

~~60. The method of Claim 59, wherein said feature extraction step comprises any mathematical transformation that enhances a particular aspect or quality of data that is useful for interpretation.~~

~~61. The method of Claim 56, wherein individual features are divided into two categories, said categories comprising:~~

~~abstract features, wherein said features are extracted using various computational methods; and~~

~~simple features that are derived from an *a priori* understanding of a system, wherein said feature is directly related to an instrument parameter or component.~~

~~62. The method of Claim 30, wherein said step of mapping said sample spectrum to one of said predefined clusters comprises:~~

~~associating said sample spectrum to one of said pre-defined clusters.~~

~~63. The method of Claim 62, further comprising a step of:~~

~~reporting said sample spectrum as an outlier if a matching cluster is not found.~~